INDUSTRIALES RESEARCH MEETING 16

NOISY ENVIRONMENTS: THE INFLUENCE ON BASIC COGNITIVE PROCESSES

GRUPO DE INVESTIGACIÓN EN INSTRUMENTACIÓN Y ACÚSTICA APLICADA

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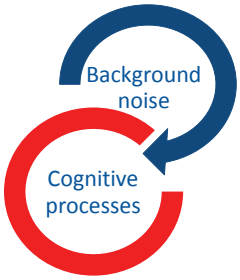
Abstract

The attention processes in people is affected by background noise produced by many different sources. Beta (13-30 Hz) and Theta (4-7 Hz) waves are directly related to attention and memory processes. Volunteers were asked to perform an attention test with and without background noise and their cerebral activity was recorded through electroencephalography (EEG). Results shows significant decreases in both beta and theta frequency bands (beta 13-30 Hz and theta 4-7 Hz) under background noise exposure. The attentional improvement is related to increases of the beta and theta waves, and we have observed that those decreases are directly related to a lack of attention caused by the exposure to background noise.

Objective

The main objective of this research is to prove the negative influence of background noise on the brain waves related to basic cognitive processes as attention and memory.



Methods (I)

1. Acoustic characterization

1.1 Survey
1.2 Noise exposure
1.3 Noise annoyance

2. Psychological evaluation

2.1 Attention tests
2.2 Memory tests
+ Background noise

3. Electrophysiological assesment

Electroencephalogram
+
Noise exposure

Methods (II)

1. Acoustic characterization

1.1 SURVEY: perception about noise

# Questions*	Participants	Mode		Educational level		
		Online	Face-to-face	Bachelor	Master	PhD
8	454	50%	50%	85%	10%	5%

1. Acoustic characterization

1.2 Noise annoyance

Obj. Subjective

Noise annoyance → ICBEN

Numeric scale range

a) Absolutamente nada (Not at all)
b) Ligeramente (Slightly)
c) Medianamente (Moderately)
d) Muy (Very)
e) Extremadamente (Extremely)

Loudness
Roughness
Sharpness
Fluctuation Strenght

Numeric scale range
a) 0 – 3.60 b) 3.61 – 23.55 c) 23.56 – 58.62, d) 58.63 – 89.77, e) 89.78 – 100

1. Acoustic characterization

1.3 Noise Exposure

Measurement strategy design → UNE-EN ISO 9612:2000

Measurement campaign → Dataloggers

Analysis of the results

$L_{Aeq,T}$
LEX_{8h}
ANSI S12.60-2010
40 dBA interior
60 dBA exterior

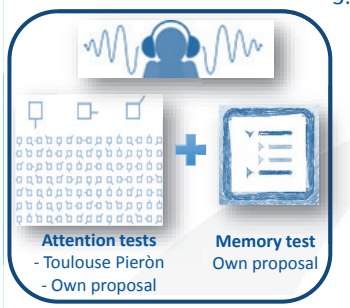
2. Psychological characterization

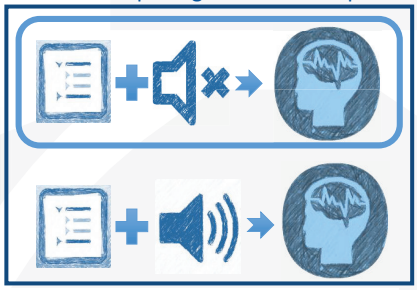
2.1 Attention tests
2.2 Memory tests

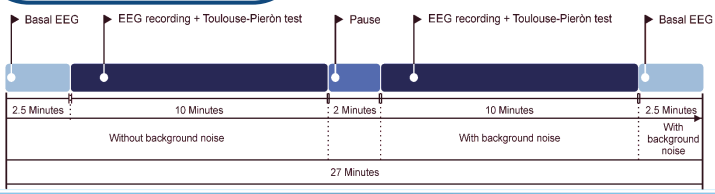
33

3. Electrophysiological assesment

3.1 Electroencephalogram + Noise exposure

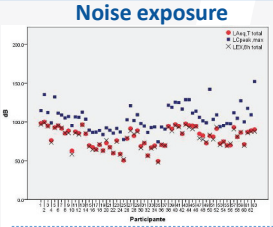




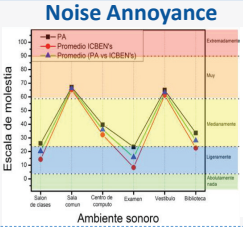


Results

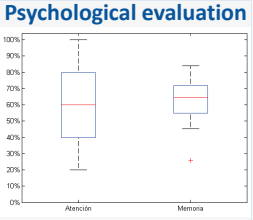
Noise exposure



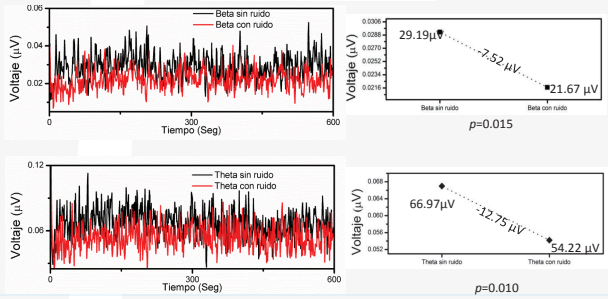
Noise Annoyance



Psychological evaluation



Electrophysiological assesment



Conclusions

- **Survey**: Sound environments studied are aggressive.
- **Levels of noise:** Excessives and not appropriate for concentration activities and the environmentes are considerated very annoying.
- **Psychometric evaluation:** Unreliable data.
- **EEG:** β y Θ decrease with influence of backround noise. We can relate it with attention and memory reductions.

Papers at Journals & Conferences

- Tristán E., Pavón G., López, J.M (2015). *"Characterization of sound environments of university students"*. Int. J. Occupational Safety and Ergonomics (JOSE).
- Tristán E., Pavón G., López, J.M. (2016) *"Evaluation of psychoacoustic annoyance and perception of noise annoyance inside university facilities"*. International Journal of Acoustics and Vibration (IJAV).